DECLARATION

I, TAKAO OCHI, a Japanese Patent Attorney registered No. 10145, of Okabe International Patent Office at No. 602, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo, Japan, hereby declare that I have a thorough knowledge of Japanese and English languages, and that the attached pages contain a correct translation into English of the priority documents of Japanese Patent Application No. 2003-167364 filed on June 12, 2003 in the name of CANON KABUSHIKI KAISHA.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

signed this 10th day of November, 2008

Takao Ochi

JAPANESE PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Applicant(s):	CANON KABUSHIKI KAISHA

October 3, 2006

Commissioner,
Japan Patent Office MAKOTO NAKAJIMA (Seal)

Certificate No. 2006-3074468

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[Date] June 12, 2003

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SHINICHIRO OTA

[International Classification] B41J 2/01

[Title of the Invention] INK JET PRINTER

[Number of the Claims] 8

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[Material] Specification 1

[Material] Drawings 1

[Material] Abstract 1

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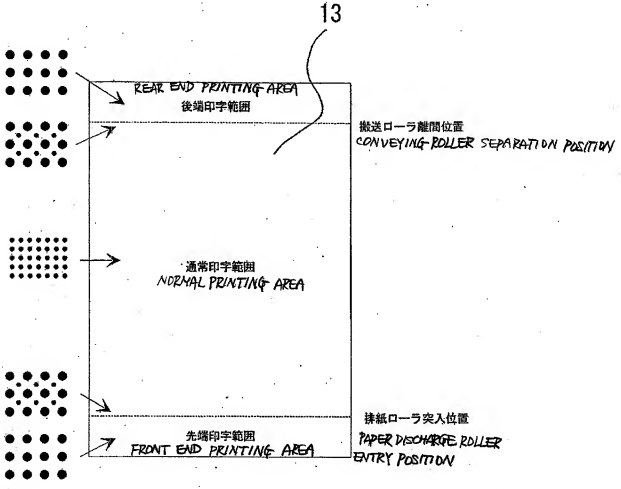
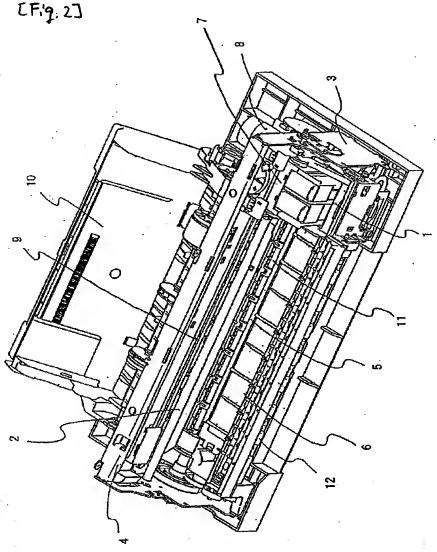
2006-3074468

【書類名】　図面
[Name of the Document] Drawings
【図１】
[Fig. 1]

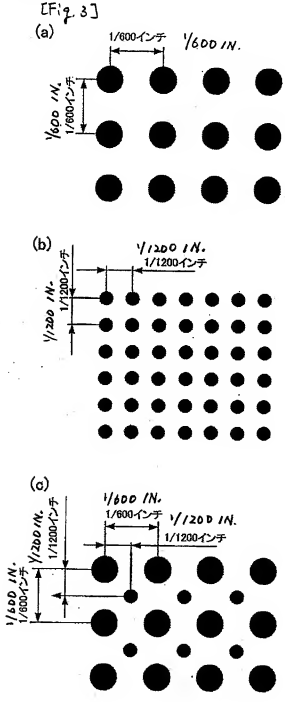


【図２】
[Fig. 2]



【図３】

[Fig. 3]


(a)
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(b)
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(c)
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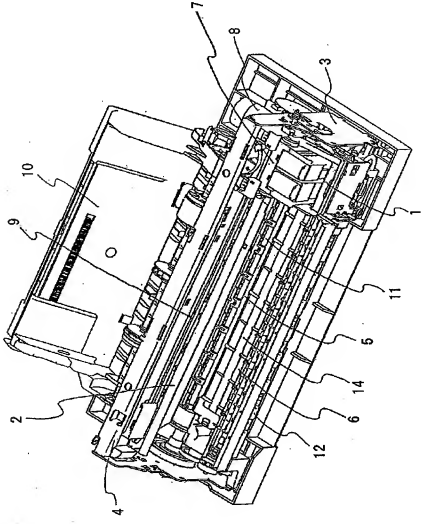
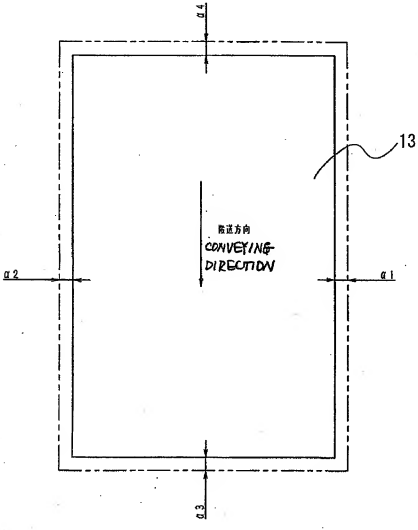
【図４】

[Fig.4]

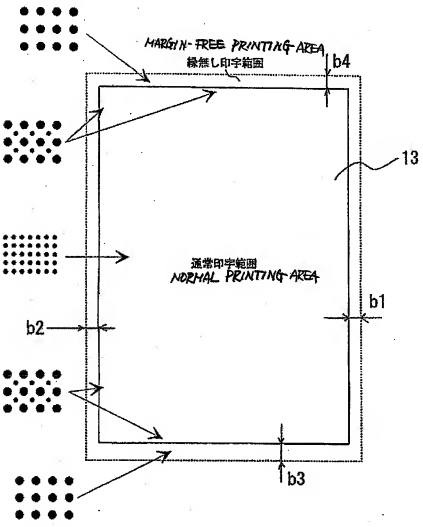


【図５】

[Fig.5]



【図６】 IF:g.6


MARGIN-FREE PRINTING AREA
縁無し印字範囲
b4
13
通常印字範囲
NORMAL PRINTING AREA
b1
b2
b3

2003-167364

[Name of the Document] Specification

[Title of the Invention] Ink Jet Printer

[What is claimed is:]

[Claim 1]

An ink jet printer comprising: a printing head mounting carrier which is held so as to freely reciprocate; a conveying roller for conveying a printing paper sheet in a direction vertical to a moving direction of the carrier; an auxiliary roller for pressing the printing paper sheet against the conveying roller; and a paper discharge roller disposed nearer the printing head than the conveying roller and adapted to discharge the printing paper sheet on which printing has been completed, and further comprising: means for making the printing head selectively discharge ink droplets such that the ink droplets are arrayed on the printing paper sheet in predetermined arrangement; and means for controlling the size of the ink droplets discharged from the printing head,

characterized in that at least one of the ratio of small-sized ink droplets and the arrangement of the ink droplets is switched depending on whether the printing paper sheet is held by the conveying roller, the auxiliary roller and the paper discharge roller.

[Claim 2]

An ink jet printer according to claim 1, wherein the ratio of the small-sized ink droplets is reduced before the printing paper sheet reaches the paper discharge roller and after the printing paper sheet has been separated from the conveying roller and the auxiliary roller.

[Claim 3]

An ink jet printer according to claim 1, wherein the ratio of ink droplets is changed stepwise in the vicinity of a boundary at which the ratio of the small-sized ink droplets is switched.

[Claim 4]

An ink jet printer according to claim 1, wherein the arrangement of ink droplets is made thin before the printing paper sheet reaches the paper discharge roller and after the printing paper sheet has been separated from the conveying roller and the auxiliary roller.

[Claim 5]

An ink jet printer according to claim 1, wherein the ratio of ink droplets is changed stepwise in the vicinity of a boundary at which the arrangement of ink droplets is switched.

[Claim 6]

An ink jet printer comprising: a printing head mounting carrier which is held so as to freely reciprocate; a conveying roller for conveying a printing paper sheet in a direction vertical to a

moving direction of the carrier; an auxiliary roller for pressing the printing paper sheet against the conveying roller; and a paper discharge roller disposed nearer the printing head than the conveying roller and adapted to discharge the printing paper sheet on which printing has been completed, and further comprising: means for making the printing head selectively discharge ink droplets such that the ink droplets are arrayed on the printing paper sheet in predetermined arrangement; and means for controlling the size of the ink droplets discharged from the printing head, said ink jet printer being constructed to perform margin-free printing by performing printing on an area which is slightly larger than the printing paper sheet,

characterized in that in a case that printing is performed on an area out of a predetermined range, the ratio of small-sized ink droplets is switched.

[Claim 7]

An ink jet printer according to claim 6, wherein in a case that printing is performed on the area out of the predetermined range, the ratio of the small-sized ink droplets is reduced.

[Claim 8]

An ink jet printer according to claim 6, wherein the ratio of ink droplets is changed stepwise in the vicinity of a boundary at which the ratio of the small-sized ink droplets is switched.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Belongs]

The present invention relates to a printing system of an ink jet printer, in particular, an ink jet printer constructed to be capable of switching the size of ink droplets to be ejected from a printing head.

[0002]

[Prior Art]

An ink jet printer constructed to perform printing by ejecting ink supplied to a printing head toward a sheet of paper with heat or vibration is now leading serial printers.

[0003]

Fig. 2 is a schematic diagram showing a configuration of a serial printer of an ink jet printing system.

A carrier 1 is supported by a guide shaft 2 and a guide rail 4 so that the carrier can be reciprocated while opposed to an LF roller 5 and a platen 6 which are held by a chassis 3. A printing head 7 is mounted on the carrier 1 to be reciprocated along the guide shaft 2 by utilizing drive force of a carrier motor 8 which is transmitted through a belt 9.

[0004]

A printing paper sheet is fed to a nip formed between the conveying roller 5 and an auxiliary roller

11 by a paper feed unit 10, and the printing paper sheet is conveyed to a predetermined printing position by the conveying roller 5. When the front end of the printing paper sheet reaches a paper discharge roller 12, the printing paper sheet is conveyed by the conveying roller 5, the auxiliary roller 11, and the paper discharge roller 12 while stably held.

[0005]

Upon printing, after a predetermined area of the printing paper sheet on which printing is to be performed has been conveyed to the position opposite to the printing head 7, the ink is ejected toward the printing paper sheet by driving the printing head 7 in accordance with printing data transmitted to the inside of the printer while the carrier 1 is moved along the guide shaft 2. Then, when driving of the printing head for one-line printing is completed, the conveying roller 5 is rotated by a predetermined amount to convey the printing paper sheet so that an area of the printing paper sheet where the next printing is to be performed is moved to the position opposite to the printing head 7. After the conveying operation of the printing paper sheet is finished, the carrier 1 starts again moving and performs the printing of the next line by driving the printing head 7 during moving. When the predetermined amount of printing data is completely printed by repeating a series of operations, the

printing paper sheet is discharged to the outside of the printer by the paper discharge roller 12 to complete the printing.

[0006]

The printing head 7 is constructed so as to independently eject ink droplets through respective nozzles by utilizing heat or vibration. In a color printer, typically, arrays of nozzles are sorted for respective colors and are arrayed in serial or in parallel. In order to promote improvement of image quality, there has been evolved a technique that the size of ink droplets is reduced such that the ink droplets thus reduced in size are finely arranged on a printing sheet of paper to reduce graininess.

[0007]

In order to finely arrange the ink droplets, the driving frequency of the printing head should be increased. However, there is an upper limit on the driving frequency. Therefore, in a case that a pitch in which the ink droplets are arranged is to be halved within the limits of the driving frequency, such a countermeasure is taken that, first, printing is performed in a pitch in which the ink droplets can be arranged at the highest possible driving frequency, then the printing is again performed on the same line while shifting the pitch by a half. However, in this case, when the printing is performed in a state that

the ink droplets are finely arranged, such a drawback associates that the throughput is reduced.

[0008]

As countermeasures, there has been proposed such a system that in a case that a text of which image quality is not so important is to be printed by switching the size of ink droplets, printing is performed with large-sized ink droplets thinly arranged, while in a case that the image quality is to be increased as in the case with image printing regardless of time required, printing is performed with small-sized ink droplets finely arranged, thereby compensating for drawbacks in respective cases.

[0009]

As a method of switching the size of ink droplets, there have been proposed various methods such as a method of switching the size of ink droplets by switching its heating time to change energy exerted thereon and a method of mixedly arranging arrays of large-sized nozzles for ejecting large-sized ink droplets and arrays of mall-sized nozzles for ejecting small-sized ink droplets in proper arrangement to perform printing.

[0010]

Fig. 3 shows schematic diagrams of a printing method using a printing head constructed to switch the size of ink droplets to be ejected.

(A) of Fig. 3 shows the case in which the larger ink droplets are ejected. The ink droplets are arrayed with a pitch of 1/600 inch (42 μm) so that a dot diameter becomes 30 μm on the printing paper sheet. (B) of Fig. 3 shows the case in which the smaller ink droplets are ejected. The ink droplets are arrayed with a pitch of 1/1200 inch (21 μm) so that the dot diameter becomes 15 μm on the printing paper sheet. Comparing these cases with each other, because the dot in (B) is smaller than that in (A), graininess of the dot in (B) is inconspicuous and high-quality recording result is obtained.

[0011]

(C) of Fig. 3 shows the case in which (A) and (B) are combined. By forming the smaller dots in the larger dots, the printing can be performed with intermediate quality between (A) and (B). The method shown in (C) of Fig. 3 is employed when the image quality which is higher than that attained in the case that the printing is performed by using the large-sized ink droplets while suppressing a reduction in throughput in comparison with the case that the printing is performed by using only the small-sized ink droplets.

[0012]

However, in a case that the printing is performed with small-sized ink droplets arranged at a high

density, such a drawback associates that the deterioration of image quality is more liable to become conspicuous than that in a case that the printing is performed with ink droplets arranged at a lower density relative to an absolute error in pitch of ink droplets on a printing paper sheet.

[0013]

On the other hand, when a printing paper sheet is conveyed, although the printing paper sheet can be conveyed with high accuracy as long as the printing paper sheet is conveyed supported by both of the conveying roller 5 and the paper discharge roller 12, the accuracy in conveyance is reduced in a case that the printing paper sheet is supported by only one of them. Specifically, the accuracy in conveyance is reduced in a front end printing area before the front end of the printing sheet reaches the paper discharge roller 12 and in a rear end printing area after the rear end of the printing sheet has been separated from the conveying roller 5. Thus, since no high accuracy in conveyance can be expected for printing performed on the front and rear ends of the printing paper sheet, the printing on these potions with small-sized ink droplets arranged at a high density causes such a problem that a failure of image quality such as unevenness is liable to generate.

[0014]

In addition, there has been proposed a so-called margin-free printing method in which printing is performed on the entire surface of a printing paper sheet with no space left. In general, this printing method is realized by performing printing on an area which is wider than a printing paper sheet used by about 2 mm. An ink absorbing member is put on a printing area extending beyond the printing paper sheet so as to prevent ink ejected to this area from remaining on a platen.

[0015]

Fig. 4 is a schematic diagram of a printer coping with margin-free printing. A carrier 1 is supported on a guide shaft 2 and a guide rail 4 so as to reciprocate opposite to an LF roller 5 and a platen 6 supported by a chassis 3. A printing head 7 is mounted on the carrier 1 so as to reciprocate along the guide shaft 2 by utilizing a driving force of a carrier motor 8 transmitted thereto via a belt 9.

[0016]

Upon printing, the printing is performed on an area which is wider than a printing paper sheet 13 by a predetermined amount, as shown in Fig. 5. In general, areas a1 to a4 (referred to as areas of extending amounts) are about 2 mm in width. The printing paper sheet 13 is fed to the nip formed between the conveying roller 5 and the auxiliary roller 11 by the paper feed

unit 10, and the printing paper sheet 13 is conveyed to the position where a predetermined extending amount a3 is met by the conveying roller 5. Under this condition, the printing head 7 is driven to eject the ink droplet toward the printing paper sheet 13, the ink droplets ejected to the portions extending beyond the printing paper sheet 13 reaches onto the ink absorbing member 14 to be absorbed thereinto.

[0017]

Then, similarly to the normal printing, the printing is performed while conveying the printing paper sheet by the predetermined amount. As to printing on both end portions, the printing is performed on areas which are wider than the printing paper sheet 13 by the amounts a1 and a2. Similarly to the ink droplets ejected to the portion extending beyond the printing paper sheet 13, the ink droplets ejected to the ranges extending beyond the both end portions of the printing paper sheet 13 are absorbed into the ink absorbing member 14. After the rear end of the printing paper sheet 13 reaches the nozzle line of the printing head 7, the printing is continued to the area of the extending amount a4. Similarly to the recording of the front end portion, the ink droplets ejected to the area extending beyond the printing paper sheet 13 are also absorbed into the ink absorbing member 14. When the printing performed on the area of the

extending amount a4 is finished, the printing paper sheet 13 is discharged outside the printer, and the margin-free printing is completed (for example, see Patent Document 1).

[0018]

[Patent Document 1]

Japanese Patent Application Laid-open No. 2002-086760

[0019]

[Problems to be Solved by the Invention]

Incidentally, in a case that the ink droplets haven been ejected to an area extending beyond the printing paper sheet 13, since the surface of the ink absorbing member 14 is situated in a position away from a nozzle surface of the printing head 7 farther than a printing surface of the printing paper sheet 13, the amount of ink droplets evaporating until the ink droplets reach the surface is increased. The ink thus evaporated turns to mist and disperses in the printer. Therefore, the ink mist is more increased in the margin-free printing than in the normal printing.

[0020]

In addition, a small-sized ink droplet is smaller than a large-sized ink droplet in heat capacity and hence is liable to evaporate. Thus, the mist is more increased in printing with the small-sized ink droplets than in printing with the large-sized ink droplets.

[0021]

Accordingly, if the printing is performed on the area extending beyond the printing sheet 13 with the small-sized ink droplets as has been conventionally performed, the mist will be more remarkably increased than that in the normal printing. If the inside of the printer is filled with the mist, various problems may occur that the mist adheres to the auxiliary roller 11 to stain the printing paper sheet and the mist adheres to the guide shaft 2 to obstruct the operation of the carrier 1.

[0022]

The present invention has been conceived in view of the above mentioned drawbacks associated with the prior art. Accordingly, one object of the present invention is to provide a printing method by which a reduction in printing paper sheet conveying accuracy induced when printing is performed on front and rear ends of the printing paper sheet is hardly exhibited as deterioration of image quality, in an ink jet printer constructed to switch the size of an ink droplet. Another object of the present invention is to reduce mist which is liable to generate by reducing the size of ink droplets, in an ink jet printer constructed to realize margin-free printing.

[0023]

In order to solve the above-mentioned troubles, the present invention reduces the ratio of the small-

sized ink droplets when printing is performed on front and rear ends of the printing paper sheet. Further, when the margin-free printing is performed, the present invention switches the ratio of ink droplets in the vicinity of an edge of the printing paper sheet and reduces the ratio of the small-sized ink droplets on an outside of the margin so as to lower mist.

[0024]

[Preferred Embodiments of the Invention]

(First Embodiment)

Next, the present invention will be specifically described with reference to the accompanying drawings.

[0025]

A printer mechanism is shown in Fig. 2 as in the case with the prior art. A printing paper sheet 13 is fed to a nip formed between the conveying roller 5 and an auxiliary roller 11 by a paper feed unit 10, and the printing paper sheet is conveyed to a predetermined printing position by the conveying roller 5. When the front end of the printing paper sheet reaches a paper discharge roller 12, the printing paper sheet is conveyed by the conveying roller 5, the auxiliary roller 11, and the paper discharge roller 12 while stably held.

[0026]

Upon printing, after a predetermined area of the printing paper sheet on which printing is to be

performed has been conveyed to the position opposite to the printing head 7, the ink is ejected toward the printing paper sheet 13 by driving the printing head 7 in accordance with printing data transmitted to the inside of the printer while the carrier 1 is moved along the guide shaft 2. Then, when driving of the printing head for one-line printing is completed, the conveying roller 5 is rotated by a predetermined amount to convey the printing paper sheet 13 so that an area of the printing paper sheet where the next printing is to be performed is moved to the position opposite to the printing head 7. After the conveying operation of the printing paper sheet is finished, the carrier 1 starts again moving and performs the printing of the next line by driving the printing head 7 during moving. When the predetermined amount of recording data is completely printed by repeating a series of operations, the printing paper sheet 13 is discharged to the outside of the printer by the paper discharge roller 12 to complete the printing.

[0027]

Fig. 1 is a schematic diagram showing an example of a printing manner according to the present invention. First, as shown in the drawing, upon printing on the front end of the printing paper sheet 13 on which the printing is performed in a state that the front end of the printing paper sheet 13 does not yet reach the

paper discharge roller, the printing is performed in a state that ink droplets of the size with which a dot of 30 μm in diameter is formed on the printing paper sheet are arrayed in a pitch of 1/600 inch (42 μm). Then, after the front end of the printing paper sheet 13 has reached the paper discharge roller to be held between the conveying roller and the paper discharge roller and hence the conveying accuracy has been increased, the printing is performed in a state that small-sized ink droplets with which a dot of 15 μm in diameter is formed are arrayed in a pitch of 1/1200 inch (21 μm), as shown in the drawing. As a result, as long as the above mentioned printing is performed, the graininess is inconspicuous and a printing result of high image quality can be obtained.

[0028]

Upon printing on the rear end of the printing sheet performed after the rear end of the printing paper sheet 13 has been separated from the conveying roller, the printing is performed in a state that ink droplets of the size with which a dot of 30 μm in diameter is formed are arrayed in a pitch of 1/600 inch (42 μm). As a result, printing of high image quality which is reduced in graininess can be performed on an area occupying almost the entire printing range of the printing paper sheet and printing by which unevenness due to disordered dot arrangement becomes inconspicuous

can be performed on the front and rear ends of the printing paper sheet where the conveying accuracy is slightly reduced and the graininess is slightly increased, but this increase in graininess is not so noticeable because of the end portions of the printing range. Therefore, there can be obtained a printing result of high image quality as a whole.

[0029]

In addition, as shown in the drawing, in the vicinity of a boundary between an area on which the printing is performed with the ink droplets having the size with which the dot of 30 μm in diameter is formed and arrayed in the pitch of 1/600 inch (42 μm) and an area on which the printing is performed with the small-sized ink droplets with which the dot of 15 μm in diameter is formed and arrayed in the pitch of 1/1200 inch (21 μm), that is, on a portion which stands a little back from a position where the printing paper sheet rushes into the paper discharge roller and a position where the printing paper sheet is separated from the conveying roller, the printing is performed by using a pattern in which large-sized and small-sized ink droplets are mixedly arrayed as shown in the drawing, while gradually changing the ratio of the small-sized ink droplets to the large-sized ink droplets, by which unnaturalness which would occur when a dot array pattern is switched can be reduced and

hence a more favorable printing result can be obtained.

[0030]

(Second Embodiment)

As the second embodiment, there will be specifically explained an example in which an increase in mist generated when the margin-free printing is performed can be suppressed by an ink jet printer capable of switching the size of ink droplets.

[0031]

The structure of the printer used is shown in Fig. 4 as in the case with the prior art. The carrier 1 is supported on the guide shaft 2 and the guide rail 4 so as to reciprocate in opposition to the LF roller 5 and the platen 6 supported by the chassis 3. The printing head 7 is mounted on the carrier 1 and reciprocates along the guide shaft 2 by using the driving force of the carrier motor 8 transmitted thereto via the belt 9.

[0032]

As shown in Fig. 6, the printing is performed on an area which is wider than the printing sheet 13 by a predetermined amount. In general, areas b1 to b4 are about 2 mm in width. First, the printing paper sheet 13 is fed by the paper feed unit 10 into a nip formed between the conveying roller 5 and the auxiliary roller 11 and then is conveyed by the conveying roller 5 to the position where a predetermined extending amount b3 is met. In this state, the printing head 7 is driven

to eject the ink droplets toward the printing paper sheet 13. The ink droplets ejected to an area extending beyond the printing paper sheet 13 reaches onto the ink absorbing member 14 to be absorbed thereinto. At that time, the printing is performed on the out-of-range area b3 using only the large-sized ink droplets of the pattern shown in (A) of Fig. 3, by which the increase in mist induced by the printing with the small-sized ink droplets can be eliminated and the increase in mist can be limited to that induced by the margin-free printing.

[0033]

Thereafter, as in the case with the normal printing, the printing is performed while conveying the printing paper sheet 13 by a predetermined conveying amount. However, the printing is performed on the both ends of the printing paper sheet, that is, the areas out of the range of portions which stand inwards of the printing paper sheet 13 by the amounts b1 and b2, by using only the large-sized ink droplets of the pattern shown in (A) of Fig. 3 as in the case with the printing on the front extending area. The printing is performed on an area inside of the areas of the amounts b1 and b2 by using the small-sized ink droplets of the pattern shown in (B) of Fig. 3.

[0034]

After the rear end of the printing paper sheet 13

has come under the nozzle array of the printing head 7, the printing is continuously performed up to the area of the extending amount b4. Also, in this case, the printing is performed on the area which is situated outside of the printing paper sheet by the extending amount b4 by using the pattern shown in (A) of Fig. 3.

[0035]

By performing the printing in the above mentioned manner, the printing of high image quality is performed on the most of the printing range with the small-sized ink droplets and the printing which is slightly low in imager quality, but can be minimized in mist is performed on the peripheral area where the deterioration of image quality is not considered to be important so much.

[0036]

In addition, on a portion in the vicinity of the boundary between the portion on which the printing of the pattern (A) is performed and the portion on which the printing of the pattern (B) is performed, which is surrounded by the areas of the extending amounts b1 to b4, the printing is performed by using the pattern in which the large-sized and small-sized ink droplets are mixed with one another as shown by (C), while gradually changing the ratio of the small-sized ink droplets to the large-sized ink droplets, by which unnaturalness induced when the dot array pattern is

switched can be reduced and hence a more favorable printing result can be obtained.

[0037]

[Effect of the Invention]

As described above, according to the present invention, wasteful ink consumption due to pre-ejection can be reduced, the durability of the printing head can be increased and a reduction in substantial printing speed can be avoided.

[Brief Description of the Drawings]

[Figure 1] A schematic diagram showing an ink dot array upon printing in a first embodiment.

[Figure 2] A schematic diagram showing a configuration of an ink jet printer.

[Figure 3] Schematic views of an ink dot array of larger dots, smaller dots, and a mixed pattern respectively.

[Figure 4] A schematic structural diagram of an ink jet printer coping with margin-free printing.

[Figure 5] A diagram showing a relation between a printing paper sheet and a printing range for the margin-free printing.

[Figure 6] A schematic diagram of an ink dot array upon printing according to a second embodiment.

[Description of Reference Numerals or Symbols]

1: carrier

2: guide shaft

3: chassis

4: guide rail

5: conveying roller

6: platen

7: printing head

8: carrier motor

9: belt

10: paper feed unit

11: auxiliary roller

12: paper discharge roller

13: printing paper sheet

14: ink absorbing member

[Name of the Document] Anstract

[Abstract]

[Subject]

In an ink jet printer constructed to change the size of ink droplets, the deterioration of image quality of images printed on front and rear ends of a printing paper sheet is avoided. In addition, an increase in mist which generates upon margin-free printing is avoided.

[Solving Means]

In a state that a printing paper sheet is supported by a conveying roller and an auxiliary roller, highly fine printing is performed by using small-sized ink droplets. Before the front end of the printing paper sheet reaches a paper discharge roller and after the rear end of the printing paper sheet has been separated from the conveying roller and the auxiliary roller, printing is performed by reducing the ratio in size of small-sized ink droplets. Upon margin-free printing, printing is performed on an area extending beyond the printing paper sheet by reducing the ratio of the small-sized ink droplets.

[Elected Drawing] None